Space Weather Technical Forecast

Issued on Monday, 19 August 2024 at 01:14 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares expected with a chance of X-class flares. Chance of G1 Minor Storms day 4 (22 Aug)

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with four M-class flares observed, the largest an M2.4 from AR3784 at 18/0204 UTC. There are twelve sunspot regions on the disc, however the majority of the flare activity is from AR3784 which remains a complex but rather compact sunspot on the northwest disc, with an unusual north-south aligned delta spot, which has remained persistent, albeit perhaps weakening slightly. Some ongoing emergence and decay has been occurring in its peripheral spots however. Other notable regions include AR3796 on near the southeast limb, which is currently hard to assess due to its proximity to the limb. However, this has some apparent growth in penumbra as it rotates into a clearer view, and bright magnetic looping evident above the spot in SDO imagery. Growth has also been observed in AR3790 in the southeast, which is comprised of a number of small mature penumbra containing spots with some mixing of polarity within its intermediate region, and AR3794 in the north, although this maintains a simple bipolar configuration.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Weak CME effects at first, from the arrival on 17 Aug, gradually eased with slow wind conditions returning. Solar winds, observed by ACE at L1, was initially slightly elevated at 450 km/s, declining after 18/1400 UTC to background, around 350-400km/s. Density eased from well above average at first, to be around average, as solar winds eased. Interplanetary Magnetic Field, Bt, was initially Moderate, at 8-15nT, but rose to give a brief peak of 21nT around 18/0830 UTC, before quickly returning to Moderate values 7-10nT, with a gradual easing trend following. The north-south component, Bz, was Weak to Moderately positive (northward) at first, before peaking around +18nT around 18/0830 UTC. This then switched to be Moderately negative (southward), with minimum -8nT, before then becoming weak and variable. Phi angle was mainly negative (toward the Sun) until around 18/1200 UTC, but then became variable. Geomagnetic activity was Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background. High energy electron flux (greater than 2MeV) observed at GOES16 was at Background. The 24-hour fluence was below the Active threshold, with 9.01e5 integrated pfu observed at 19/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High activity expected with further occasional M-class flares, and a chance of isolated X-class flares.

Solar Wind /Geomagnetic Activity: There are no Earth directed CMEs, however a CME off the north-disc on 17 Aug has a slight chance of giving a glancing arrival on day 3 (21 Aug). Otherwise mainly background winds are expected until the onset of any fast wind of CH60/+. This potentially occurring on day 4 (22 Aug), however confidence is low. Quiet geomagnetic activity expected with a slight chance of Unsettled intervals, but with a chance of increasing to

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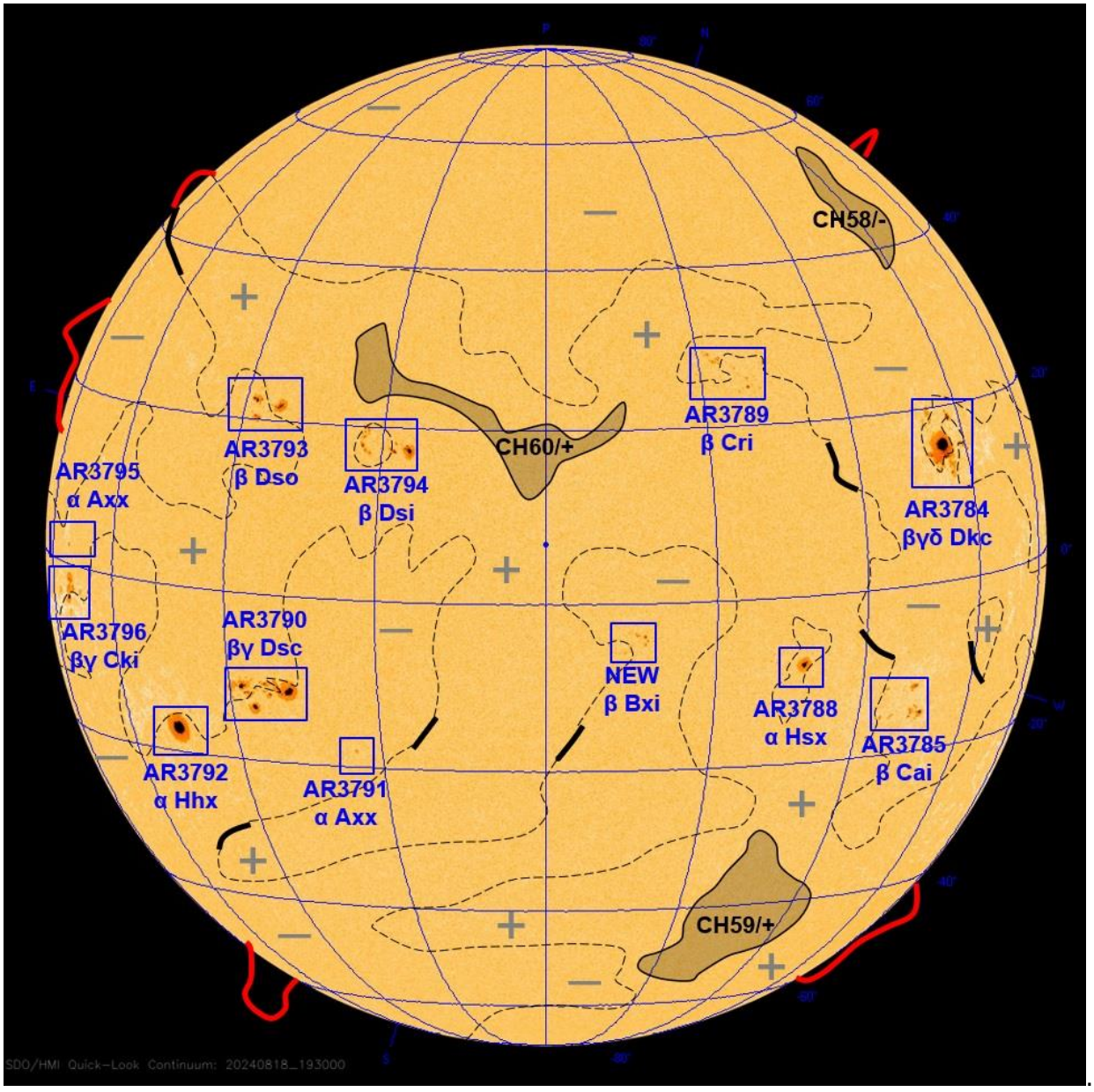
Active to G1 Minor Storm with any coronal hole onset on day 4 (22 Aug). Any CME glance also brings a very slight chance of Active to G1 Minor Storms on day 3 (21 Aug).

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at Background, with a slight chance of breaching S1 Minor solar radiation storm level should any notable flares occur, primarily from AR3784. The high energy electron flux is expected to remain at background at first, but with a chance of increasing to Moderate at times as solar winds ease later in the period. The associated 24 hour fluence is expected to be below the Active level.

Figure 1. Solar Analysis Valid 18/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

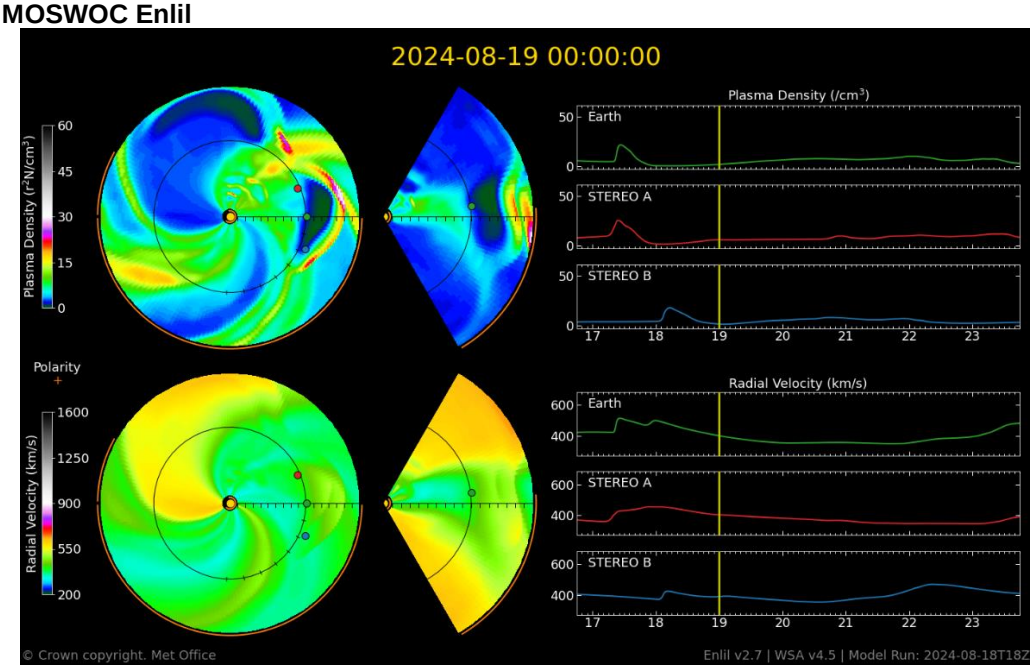
The only CME of note appears to be from a broad upper coronal reconfiguration, occurring from around 17/1030 UTC. This resultant CME is likely to pass north of Earth, but has a small chance of giving glancing impacts on day 4 (21 Aug).

Otherwise, mainly background winds are expected, but with a chance of an enhancement from small central disc coronal hole by day 4 (22 Aug). As a positive feature, and approaching the September equinox, this could result in G1 Minor Storms (Russell-McPherron effect). However confidence is low due to the feature not being a persistent feature from last rotation, and MOSWOC Enlil currently limiting any enhancement until day 5 (23 Aug).

Mainly Quiet conditions expected with isolated Unsettled intervals, until later on day 4 (22 Aug), with any fast wind arrival bringing Unsettled to Active with a chance of G1 Minor Storms. There is also a very slight chance of Active to G1 Minor Storms on day 3 (21 Aug) if any CME glance occurs.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	25
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil



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Radio Blackouts - X-Ray Flares:

There are twelve sunspot regions currently on the visible disc, with Moderate to High activity expected. The majority of the recent M-flare activity has been from a combination of AR3784 in the northwest, AR3790 in the southeast and AR3796 near the southeast limb.

AR3784 remains the most complex region on the disc, but is now approaching the northwest limb and is expected to rotate over this on day 3 (21 Aug). Despite a persistent, albeit perhaps weakening, North-south aligned delta spot to the south of the main umbra region, along with other transient developments to its north and northwest, the region has remained relatively quiet since its X1.1 flare on 14 Aug, but maintains a notable flare potential.

AR3790 consists of a collection of small and mature spots with penumbra. This has a simpler E-W bipolar configuration, but with some mixing of polarities within its intermediate spots, resulting in a beta-gamma configuration. Recently numbered AR3796 is gradually becoming clearer to view. This has a rather ragged north-south magnetically aligned penumbral area, but with only a positive leader umbra within its southern extent, though surrounded by a broad area of plage. This still remains at a relatively oblique viewing angle however, and more details are likely to become apparent over time.

The other spots are generally smaller and simpler, however new flux emergence, just west of the south-centre disc, and growth within AR3794 in the northeast, all suggest the potential for flare activity. Overall, further M-class flares are expected, with a chance of isolated X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	80	70
Very Active	R3 to R5 X Class	No	25	25	25	15

Figure 3a: GOES 16/18 X-ray Flux

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Figure 3b: SDO imagery of AR3784

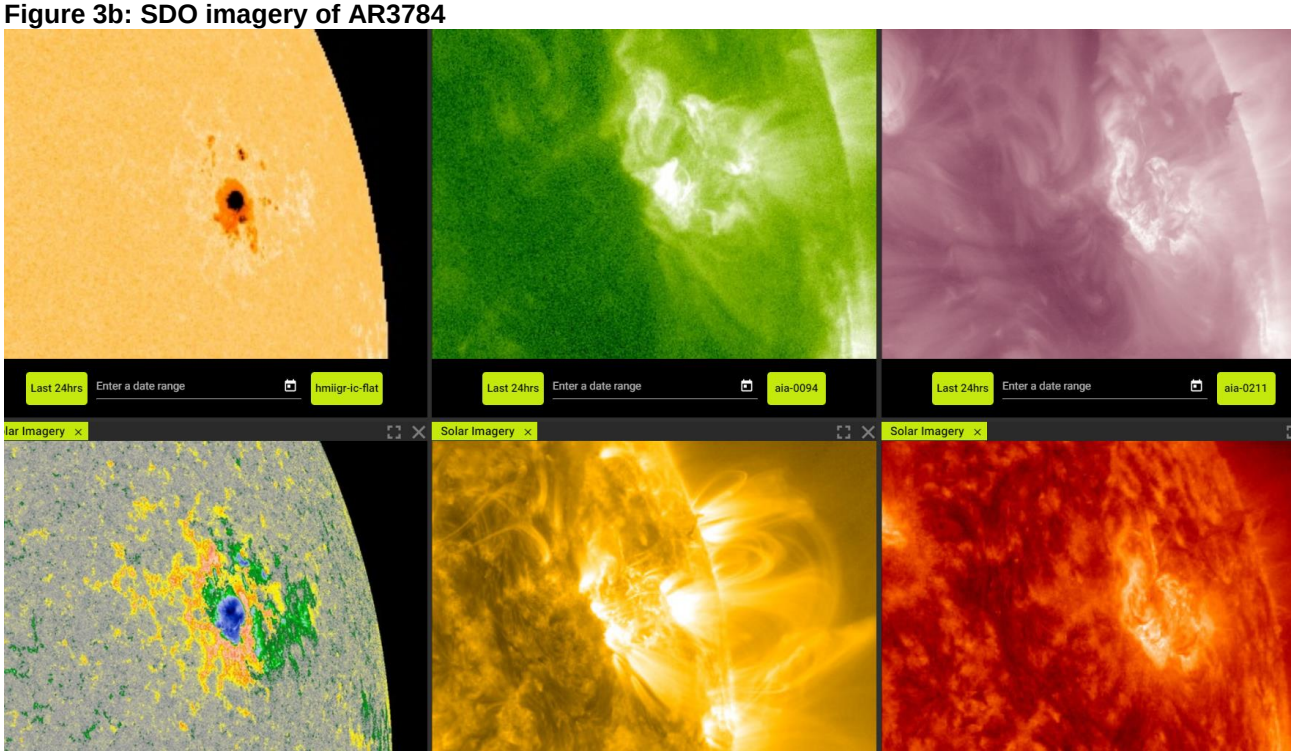
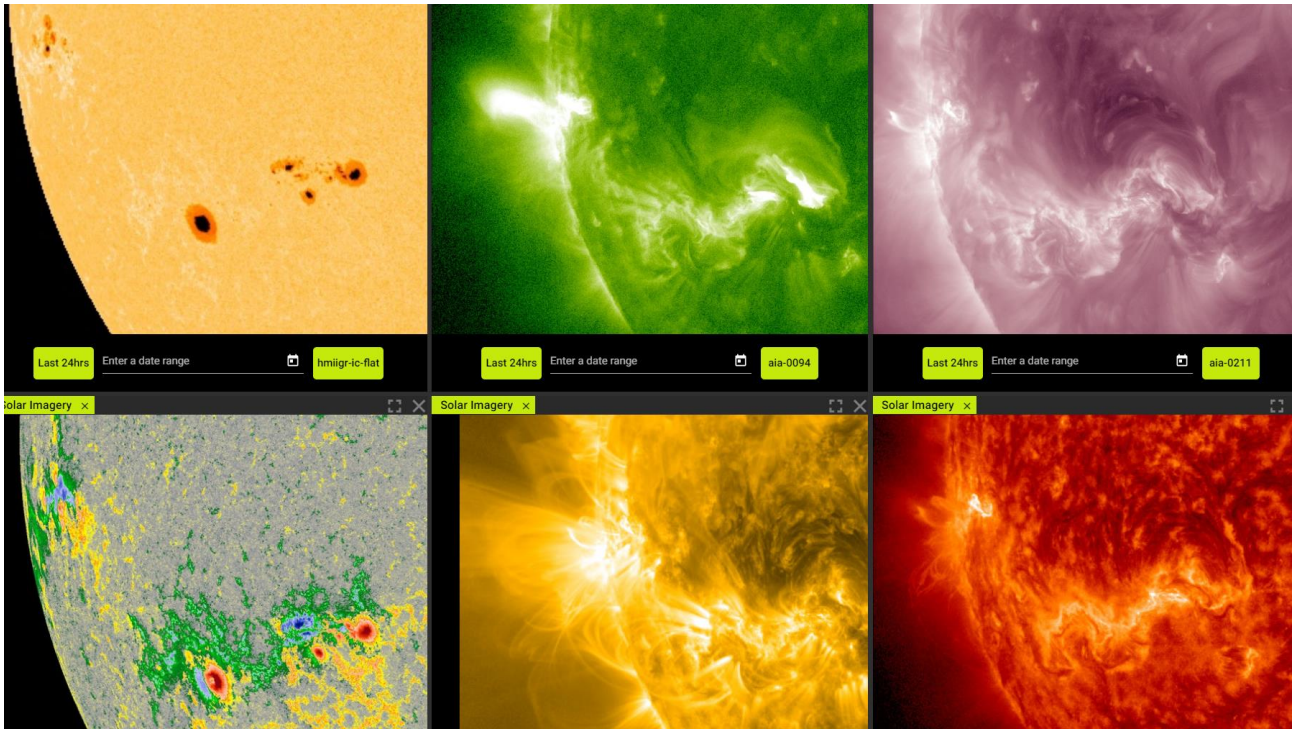


Figure 3c: SDO imagery of SE disc (including AR3796 nr limb, AR3792 and AR3790)



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES-18 is expected to persist at background, but with a chance of rising in response to any notable flares. This most likely from AR3784 on the northwest visible disc. While this is expected to rotate over the western limb on day 3 (21 Aug), the regions in currently in the eastern disc will then have moved into a more geoeffective location. There is a slight chance of reaching the S1 Minor Radiation Storm threshold.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	15
Very Active	**≥ S3 ***	No	5	5	5	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy flux, observed by GOES-16, is expected to be mostly at background. However, after the easing of recent slightly elevated winds from the CME arrival on 17 Aug, there is a chance of moderate levels returning, perhaps approaching High at diurnal peak.

The associated 24 hour electron fluence is forecast to remain below Active, but could see a rising trend later in the period. MOSWOC REFM has a short-term increasing trend, which is currently not expected, with any enhancement expected to be more gradual over the period, if it does occur at all.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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